

**SCHULTZ - HANFORD AREA**  
**TRANSMISSION-LINE PROJECT**

***ADDENDUM #2 to***

***APPENDIX I***  
***ELECTRICAL EFFECTS***

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## **Table of Contents**

<b>ADDENDUM #2 .....</b>	<b>A2-1</b>
A2.1 New configurations .....	A2-1
A2.2 Electric-field levels .....	A2-2
A2.3 Magnetic-field levels .....	A2-2
A2.4 Audible-noise levels .....	A2-3
A2.5 Electromagnetic interference .....	A2-3
A2.6 Conclusions .....	A2-3
 <b>List of Preparers .....</b>	 <b>A2-3</b>

### **List of Tables**

Table A2-1:	Physical and electrical characteristics of new Schultz – Hanford Area Transmission-line Project configurations.....	A2-5
Table A2-2:	New configurations for Schultz – Hanford Area Project. ....	A2-7
Table A2-3:	Calculated peak and edge-of-right-of-way electric fields for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum voltage. ....	A2-8
Table A2-4:	Calculated peak and edge-of-right-of-way magnetic fields for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum current. ....	A2-9
Table A2-5:	Predicted foul-weather audible noise (AN) levels at edge of right-of-way (ROW) by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line. ....	A2-10
Table A2-6:	Predicted fair-weather radio interference (RI) levels at 100 feet (30.5 m) from the outside conductor by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line. ....	A2-11
Table A2-7:	Predicted maximum foul-weather television interference (TVI) levels predicted at 100 feet (30.5 m) from the outside conductor by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line. ....	A2-11

### **List of Figures**

Figure A2-1:	New configurations for proposed Schultz – Hanford Area Transmission-line Project 500-kV line. ....	A2-13
Figure A2-2:	Electric-field profiles for new configurations of proposed Schultz – Hanford/Wautoma 500-kV line for maximum voltage and minimum clearance.....	A2-19
Figure A2-3:	Magnetic-field profiles for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line for maximum currents and minimum clearances... ..	A2-22

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## **ADDENDUM #2**

In the course of evaluating routing locations for the proposed Schultz-Hanford Area Transmission-line Project, five additional corridor layouts were identified: three in Segment A and two in Segment D. They entail different configurations than those analyzed in the original Electrical Effects and Health Assessment appendices prepared for the project. The purpose of this addendum is to report the levels of electric fields, magnetic fields, audible noise, radio interference, and television interference anticipated from these five new configurations. The predicted levels from the proposed lines are compared with those from the no-action alternative in the same area. A previous Addendum described two additional configurations in Segments G and D.

Two of the new corridor configurations in Segment A (designated Configurations A-1A and A-1B) would be located in the area of Kittitas County where the proposed line would cross Coleman Road and Cookes Creek. The other three new corridor configurations incorporate structures with the conductors in a flat configuration instead of the delta (triangular) configuration that was originally considered. The flat configuration would be introduced in Segments A and B<sub>south</sub> where the line crosses the Yakima Training Center (A-1C), in Segment D just south of the Vantage Substation (D-1B), and in a short section of Segment D just south of the Midway Substation (D-2A).

The calculation methods and impacts related to electric and magnetic fields and corona-generated audible noise and electromagnetic interference are discussed in the Electrical Effects appendix. An elevation of 2380 feet (ft.) (726 meters [m]) was assumed in the calculations for the Configurations A-1A and A1- B; 2000 ft. (610 m) was assumed for Configuration A-1C; and 1200 ft. (366 m) was assumed for Configurations D1-B and D-2A.

Since the initial Electrical Effects appendix was completed, the Bonneville Power Administration has adopted a slightly modified structure design for single-circuit delta-configuration 500-kV lines. The new design incorporates larger spacing between phases to allow for increased reliability and reduction of audible noise. In the new design, the horizontal spacing between phases is 48 ft. (14.6 m) and the vertical spacing is 34.5 ft. (10.5 m). The minimum and average clearances are 35 and 45 ft. (10.7 and 13.7 m), respectively. In the analyses presented here, the newer design was assumed for both the proposed Schultz – Hanford/Wautoma and the rerouted Vantage – Schultz 500-kV lines in Configurations A-1A and A-1B. (See Table A2-1 and Figure A2-1.)

Incorporation of the new structure design into the delta configurations that were analyzed previously would not significantly change the electric-field, magnetic-field, or corona-related effects. Therefore the discussion and conclusions presented in the Electrical Effects appendix and Addendum #1 are still valid.

The new flat configuration incorporates a horizontal spacing of 35 ft. (10.7 m) between conductor bundles and would require a 180-ft. (55-m) right-of-way (ROW). The minimum clearance is 36 ft. (11 m); the average clearance is about 46 ft. (14 m).

### **A2.1 New configurations**

The new corridor configurations for the Schultz – Hanford/Wautoma 500-kV line would replace those short sections of Segments A, B, and D previously included in the analyses of Configurations A-1, D-1, and D-2. The new configurations are as follows:

- Configuration A-1A would be a 5.7-mile section of Segment A where the route crosses Coleman Road and Cookes Creek. In this section the proposed Schultz – Hanford/Wautoma 500-kV line would parallel the existing Vantage – Schultz 500-kV line with a 200-foot spacing;
- Configuration A-1B would be a 1.4-mile section of Segment A in the area where the route crosses Coleman Road and Cookes Creek. In this section the proposed line would parallel a rerouted Vantage – Schultz 500-kV line with a separation of 200 feet on new right-of-way.
- Configuration A-1C would be a 14.8-mile section of Segments A and B<sub>south</sub> where these routes cross the north end of the Yakima Training Center. In this section the proposed Schultz – Hanford/Wautoma 500-kV line would be constructed in a flat configuration without any parallel lines. It would require an additional 30 ft. (9 m) of ROW beyond that required for Configuration A-1.
- Configuration D-1B would be a 4.7-mile section of Segment D just south of the Vantage Substation where the proposed line crosses Saddle Mountain. In this section the proposed Schultz – Hanford/Wautoma 500-kV line would be constructed in a flat configuration parallel to the existing Vantage – Midway 230-kV line. It would require an additional 15 ft. (4.6 m) of ROW beyond that for Configuration D-1 for a total of 165 ft. (50.3 m) of new ROW.
- Configuration D-2A would be a 1.7-mile section of Segment D just south of the Midway Substation where the proposed line crosses the Hanford Monument. In this section the proposed Schultz – Hanford/Wautoma 500-kV line would be constructed in a flat configuration parallel to the existing North Bonneville – Midway 230-kV, Midway – Moxee 115-kV, Midway – Grandview 115-kV, and Big Eddy – Midway 230-kV lines. It would require an additional 15 ft. (4.6 m) of new ROW beyond that for Configuration D-2, for a total of 165 ft. (50.3 m) of new ROW.

Figure A2-1 shows these configurations; their physical and electrical characteristics are given in Tables A2-1 and A2-2.

## **A2.2 Electric-field levels**

Calculated electric fields for the five new configurations are summarized in Table A2-3 and plotted in Figure A2-2. The peak electric-field levels for the new configuration would be comparable with each other and with levels for other 500-kV line configurations in the project. Peak values for the five configurations are between 8.6 and 8.7 kV/m for minimum clearance conditions. The electric fields at the edges of the right-of-way for the new configurations would be lower near the proposed and rerouted 500-kV lines (about 2.5 kV/m) than near the existing Vantage – Schultz 500-kV line in Configuration A1-A (about 5.3 kV/m).

The new flat configuration would result in comparable peak and edge-of-ROW fields to those from the delta configuration that it would replace. However, it would require a wider ROW.

## **A2.3 Magnetic-field levels**

Calculated magnetic-field levels for the five new configurations are summarized in Table A2-4 and plotted in Figure A2-3. The peak and edge-of-right-of-way field levels for the new configurations are similar to each other and to levels in other configurations for the proposed 500-kV line. The maximum magnetic field under the new configurations would be about 257 mG (Configurations D1-B and D2-A). The edge-of-right-of-way fields adjacent to the 500-kV lines in the new configurations would be about 70 mG. At the edge of the ROW away from the 500-kV lines, the magnetic fields would be lower. These magnetic-field levels would be lower than those that would be under and adjacent to the existing Vantage – Schultz 500-kV line under the no-action alternative.

## **A2.4 Audible-noise levels**

Corona-generated audible-noise (AN) levels from the new configurations are shown in Table A2-5. The foul weather  $L_{50}$  and  $L_5$  levels predicted for the edge of right-of-way nearest the proposed line will be comparable with those for the previously considered configurations. AN levels at both edges of the right-of-way of Configuration A-1A would be dominated by noise from the existing Vantage – Schultz 500-kV line. The AN from the existing line exceeds that observed for other configurations in the project; the foul-weather  $L_{50}$  at the edge of the right-of-way is about 65 dBA. The proposed line would only add about 1 dBA to the existing levels at both edges of the Configuration A-1A right-of-way. The foul weather  $L_{50}$  levels at the edges of the ROW of the other new configurations would be much lower and would not exceed the 50-dBA limit established by BPA.

## **A2.5 Electromagnetic interference**

Corona-generated electromagnetic interference levels for the new configurations are shown in Tables A2-6 for radio interference (1 MHz) and in Table A2-7 for television interference (75 MHz). The levels would be at 100 ft. from the outside conductors for all new configurations except Configuration A1-A. For Configuration A1-A, electromagnetic interference levels are determined by levels from the existing Vantage – Schultz 500-kV line. The levels near the other new configurations are similar to those from other configurations in the project.

## **A2.6 Conclusions**

The predicted levels for electric fields, magnetic fields, and corona effects from the new configurations are very similar to those calculated for the original configurations. Therefore, they do not change the basic conclusions of either the Electrical Effects or Health Assessment appendices that were prepared previously. The levels of corona-related effects for Configuration A-1A are strongly influenced by levels from the existing Vantage – Schultz 500-kV line. The older single-conductor design for this line results in significantly more corona activity than the three-conductor bundle design proposed for the new and rerouted lines.

## **List of Preparers**

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**Table A2-1: Physical and electrical characteristics of new Schultz - Hanford Area Transmission-line Project configurations.**

Configuration	A-1A, A-1B	A-1A	A-1B	A-1C, D-1B, D-2A	D-1B
Line Description	Proposed Schultz – Hanford/ Wautoma 500-kV	Existing Vantage – Schultz 500-kV	Rerouted Vantage – Schultz 500-kV	Proposed Schultz – Hanford/ Wautoma 500-kV	Existing Vantage – Midway 230-kV
Voltage, kV Maximum/Average <sup>1</sup>	550/540	550/540	550/540	550/540	242/235
Peak current, A No-action/Proposed <sup>2</sup>	-/1436	1355/738	1355/738	-/1436	609/593
Electric phasing	BAC	BAC	BAC	BAC	ABC
Clearance, ft. Minimum/Average <sup>1</sup>	35/45	33/47	35/45	36/46	30/42
Centerline distance/direction from Schultz – Hanford/Wautoma 500-kV Line, ft.	-	200W	200W	-	125E
Centerline distance to edge of ROW, ft.	75	75	75	90	50
Tower configuration	Delta	Flat	Delta	Flat	Flat
Phase spacing, ft. <sup>3</sup>	48H, 34.5V	49	48H, 34.5V	35H	27H
Conductor: #/ diameter, in.; spacing, in.	3/ 1.300; 17.04	1/ 2.50	3/ 1.300; 17.04	3/1.300; 17.04	1/1.0

<sup>1</sup> Average voltage and average clearance used for corona calculations.

<sup>2</sup> Minus sign indicates current flow in opposite direction to flow in parallel proposed Schultz – Hanford/Wautoma line.

<sup>3</sup> H = horizontal feet; V = vertical feet

**Table A2-1, continued**

<b>Configuration</b>	<b>D-2A</b>			
<b>Line Description</b>	<b>Existing N. Bonneville – Midway 230-kV</b>	<b>Existing Midway – Moxee 115-kV</b>	<b>Existing Midway – Grandview 115-kV</b>	<b>Existing Big Eddy – Midway 230-kV</b>
<b>Voltage, kV Maximum/Average<sup>1</sup></b>	242/235	121/117	121/117	242/235
<b>Peak current, A No-action/Proposed<sup>2</sup></b>	537/518	153/154	308/293	779/730
<b>Electric phasing</b>	ABC	ABC	ABC	ABC
<b>Clearance, ft. Minimum/Average<sup>1</sup></b>	30/42	25/35	25/35	30/42
<b>Centerline distance/direction from Schultz – Hanford/ Wautoma 500-kV Line, ft.</b>	375E	287.5E	237.5E	137.5E
<b>Centerline distance to edge of ROW, ft.</b>	187.5	-	-	62.5
<b>Tower configuration</b>	Flat	Flat	Flat	Flat
<b>Phase spacing, ft.<sup>3</sup></b>	27H	12H	12H	27H
<b>Conductor: #/ diameter, in.; spacing, in.</b>	1/1.108	1/0.655	1/0.563	1/1.138

<sup>1</sup> Average voltage and average clearance used for corona calculations.

<sup>2</sup> Minus sign indicates current flow in opposite direction to flow in parallel proposed Schultz – Hanford/Wautoma line.

<sup>3</sup> H = horizontal feet; V = vertical feet

**Table A2-2: New configurations for Schultz - Hanford Area Project**

<b>Segment- Configuration</b>	<b>Description of other lines in corridor with Schultz – Hanford/Wautoma 500-kV line</b>	<b>Miles</b>
<b>A-1A</b>	<b>Existing Vantage – Schultz 500-kV line</b>	<b>5.7</b>
<b>A-1B</b>	<b>Rerouted Vantage – Schultz 500-kV line</b>	<b>1.4</b>
<b>A-1C</b>	<b>None</b>	<b>14.8</b>
<b>D-1B</b>	<b>Existing Vantage - Midway 230-kV line</b>	<b>4.7</b>
<b>D-2A</b>	<b>Existing N. Bonneville – Midway 230-kV line Existing Midway - Moxee 115-kV line Existing Midway - Grandview 115-kV line Existing Big Eddy - Midway 230-kV line</b>	<b>1.7</b>

**Table A2-3: Calculated peak and edge-of-right-of-way electric fields for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum voltage.** Configurations are described in Tables A2-1 and A2-2.

a) **Peak electric field on right-of-way, kV/m**

Location	Proposed Corridor		No-action Alternative Corridor	
Line Clearance	Minimum	Average	Minimum	Average
<b>A-1A</b>	8.7	5.8	8.5	5.1
<b>A-1B</b>	8.6	5.8	-	-
<b>A-1C</b>	8.7	5.2	-	-
<b>D-1B</b>	8.7	5.2	3.1	1.8
<b>D-2A</b>	8.7	5.2	3.3	1.9

b) **Edge-of-right-of-way electric field, kV/m**

Location	Proposed Line <sup>1</sup>		No-action Alternative Corridor <sup>1</sup>	
Line Clearance	Minimum	Average	Minimum	Average
<b>A-1A</b>	2.5, 5.3	2.5, 4.1	5.2	4.1
<b>A-1B</b>	2.5, 2.5	2.4, 2.4	-	-
<b>A-1C</b>	2.6	2.5	-	-
<b>D-1B</b>	2.6, 2.0	2.5, 1.5	2.0	1.5
<b>D-2A</b>	2.6, 0.1	2.5, 0.1	1.4, 0.1	1.2, 0.1

<sup>1</sup> Electric field at edge of right-of-way adjacent to proposed line is given first.

**Table A2-4: Calculated peak and edge-of-right-of-way magnetic fields for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum current.** Configurations are described in Tables A2-1 and A2-2.

a) **Peak magnetic field on right-of-way, mG**

Location	Proposed Corridor		No-action Alternative Corridor	
Line Clearance	Minimum	Average	Minimum	Average
<b>A-1A</b>	229	155	288	185
<b>A-1B</b>	234	159	-	-
<b>A-1C</b>	251	164	-	-
<b>D-1B</b>	257	169	133	84
<b>D-2A</b>	257	170	165	101

b) **Edge-of-right-of-way magnetic field, mG**

Location	Proposed Corridor <sup>1</sup>		No-action Alternative Corridor <sup>1</sup>	
Line Clearance	Minimum	Average	Minimum	Average
<b>A-1A</b>	71, 88	62, 66	158	117
<b>A-1B</b>	68, 38	59, 33	-	-
<b>A-1C</b>	70	60	-	-
<b>D-1B</b>	68, 65	58, 47	67	49
<b>D-2A</b>	67, 5	57, 5	62, 7	50, 7

<sup>1</sup> Magnetic field at edge of right-of-way adjacent to proposed line is given first.

**Table A2-5: Predicted foul-weather audible-noise (AN) levels at edge of right-of-way (ROW) by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line.** AN levels expressed in decibels on the A-weighted scale (dBA). L<sub>50</sub> and L<sub>5</sub> denote the levels exceeded 50 and 5 percent of the time, respectively. For the parallel-line configurations<sup>1</sup>, the AN level at the edge of the proposed Schultz-Hanford Area Transmission-line Project ROW is given first.

Configuration <sup>1</sup>	Foul-weather AN					
	Proposed			No-action Alternative		
	ROW ft. (m)	L <sub>50</sub> , dBA	L <sub>5</sub> , dBA	ROW ft. (m)	L <sub>50</sub> , dBA	L <sub>5</sub> , dBA
<b>A-1A</b>	350 (107)	59, 65	62, 68	150 (46)	65	68
<b>A-1B</b>	350 (84)	50, 50	54, 54	-	-	—
<b>A-1C</b>	180 (55)	49	53	-	-	-
<b>D-1B</b>	265 (81)	49, 48	52, 52	100 (30)	44	47
<b>D-2A</b>	652.5 (199)	49, 42	52, 45	487.5 (149)	39, 37	42, 41

<sup>1</sup> Configurations are described in Tables A2-1 and A2-2.

**Table A2-6: Predicted fair-weather radio interference (RI) levels at 100 feet (30.5 m) from the outside conductor by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line.** RI levels given in decibels above 1 microvolt/meter (dBμV/m) at 1.0 MHz. L<sub>50</sub> denotes level exceeded 50 percent of the time. For the parallel-line configurations, the RI level on the side of the proposed Schultz – Hanford Area Line Transmission-line Project ROW is given first.

Configuration <sup>1</sup>	Fair-weather RI	
	Proposed	No-action Alternative
	L <sub>50</sub> , dBmV/m	L <sub>50</sub> , dBmV/m
A-1A	38, 48	48
A-1B	38, 38	-
A-1C	38	-
D-1B	37, 31	31
D-2A	37, 28	22, 28

<sup>1</sup> Configurations are described in Tables A2-1 and A2-2.

**Table A2-7: Predicted maximum foul-weather television interference (TVI) levels predicted at 100 feet (30.5 m) from the outside conductor by configuration of the proposed Schultz – Hanford/Wautoma 500-kV line.** TVI levels given in decibels above 1 microvolt/meter (dBμV/m) at 75 MHz. For the parallel-line configurations, the TVI level on the side of the proposed Schultz – Hanford Area Transmission-line Project ROW is given first.

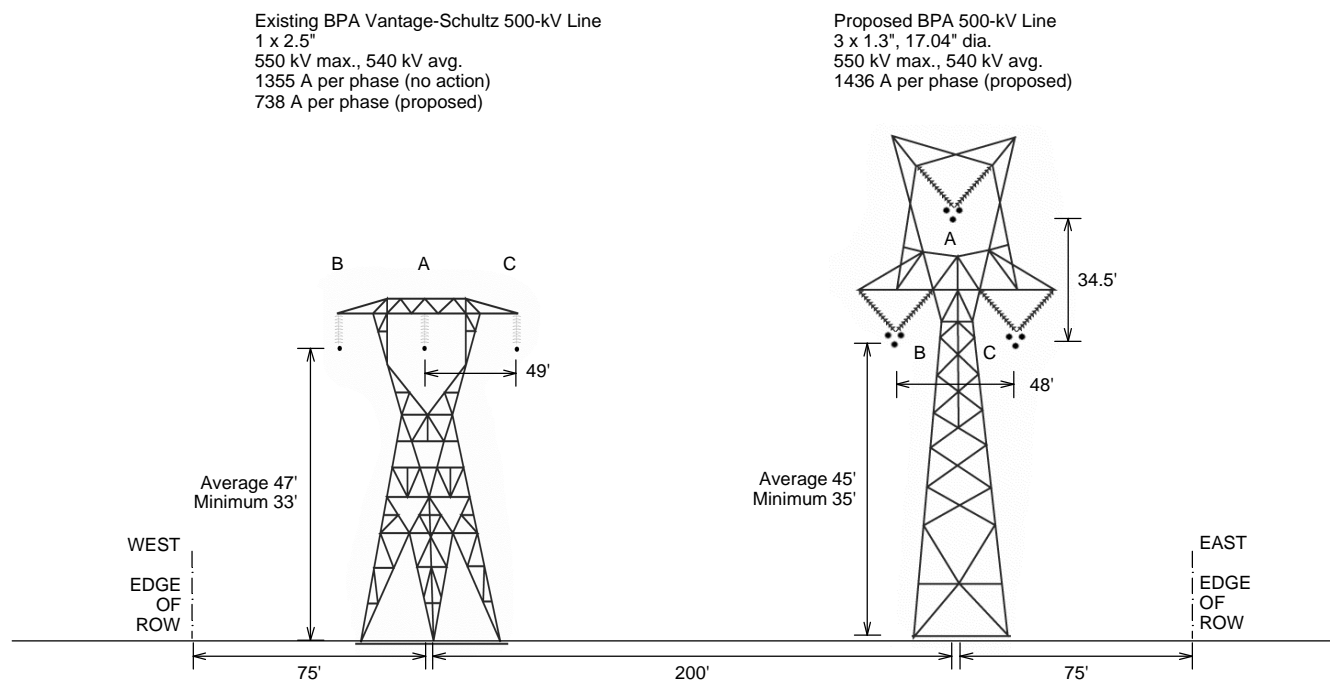
Configuration <sup>1</sup>	Foul-weather TVI	
	Proposed	No-action Alternative
	Maximum (foul), dBmV/m	Maximum (foul), dBmV/m
A-1A	25, 35	35
A-1B	25, 25	-
A-1C	23	-
D-1B	22, 19	18
D-2A	22, 16	9, 15

<sup>1</sup> Configurations are described in Tables A2-1 and A2-2.

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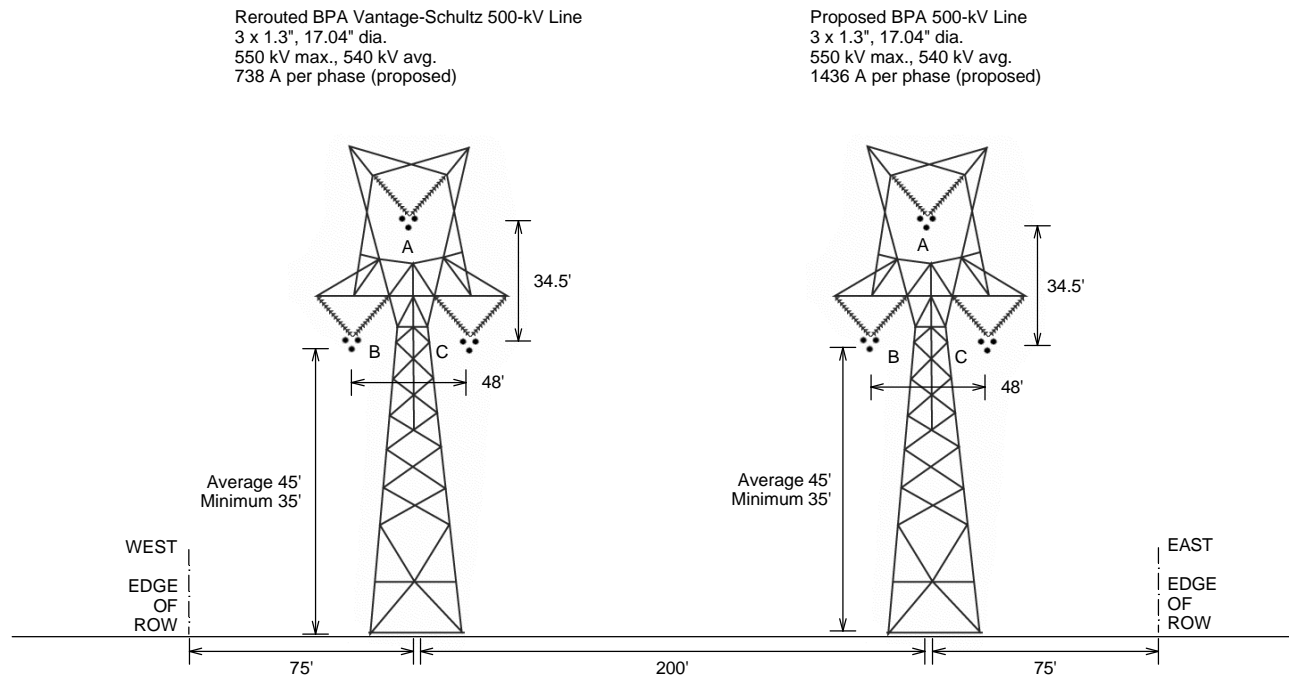
**Figure A2-1: New configurations for proposed Schultz - Hanford Area Transmission-line Project 500-kV line:**  
**a) Configuration A-1A; b) Configuration A-1B; c) Configuration A-1C; d) Configuration D-1B; and**  
**e) Configuration D-2A.**  
(5 pages)

a) Configuration A-1A - Proposed 500-kV line parallel to existing Vantage – Schultz 500-kV line (not to scale)



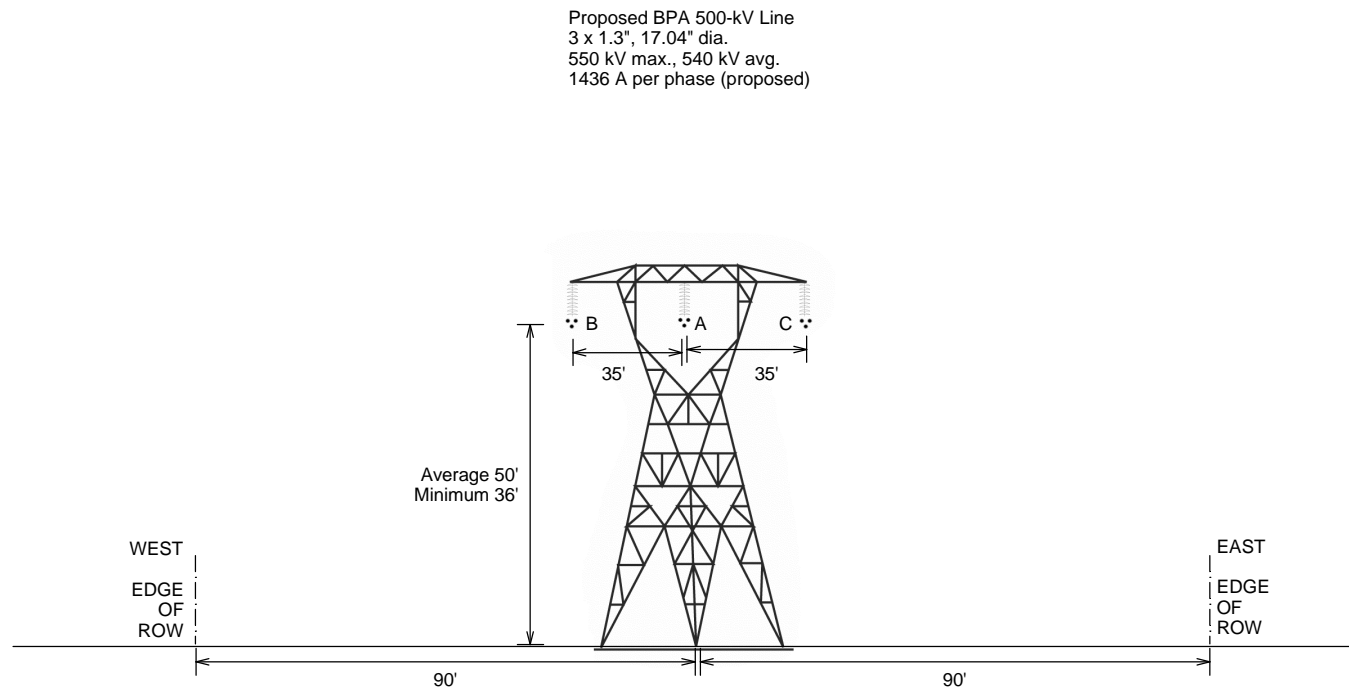
**Figure A2-1, continued**

b) Configuration A-1B - Proposed 500-kV line parallel to rerouted Vantage – Schultz 500-kV line (not to scale)



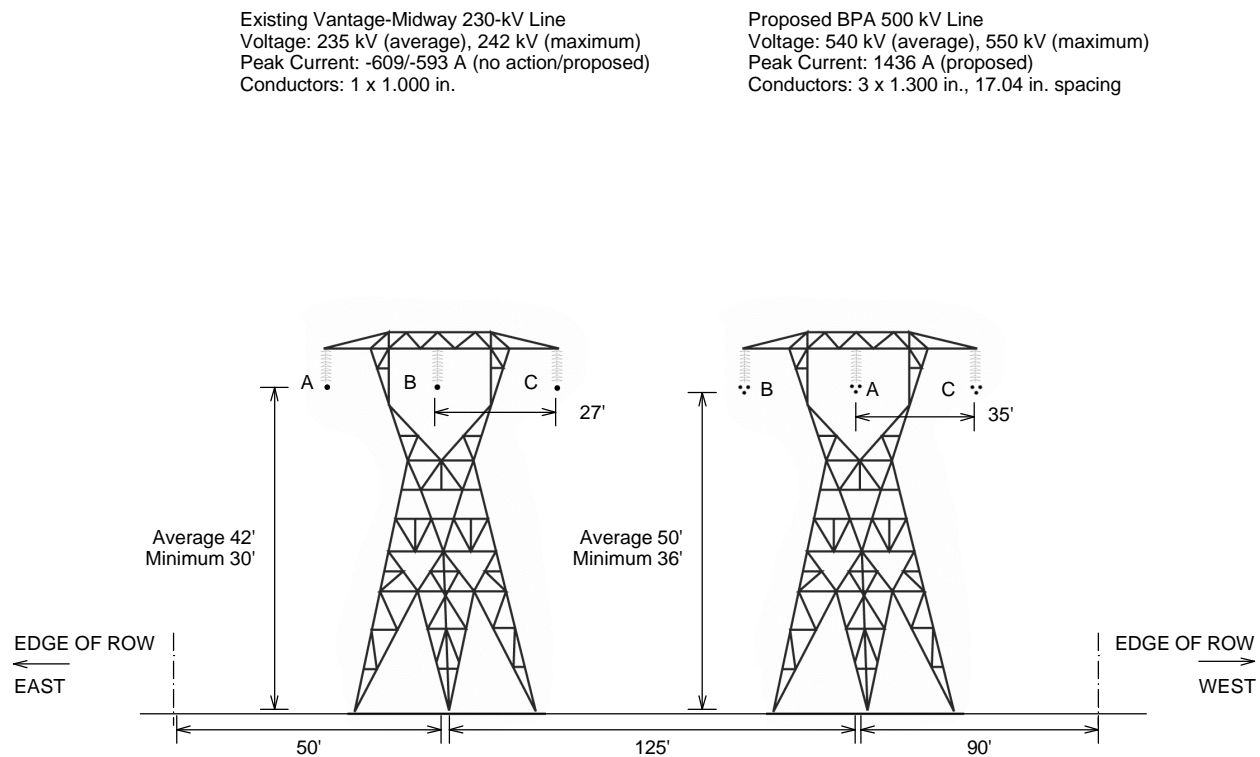
**Figure A2-1, continued**

c) Configuration A-1C - Proposed 500-kV line on flat structures (not to scale)



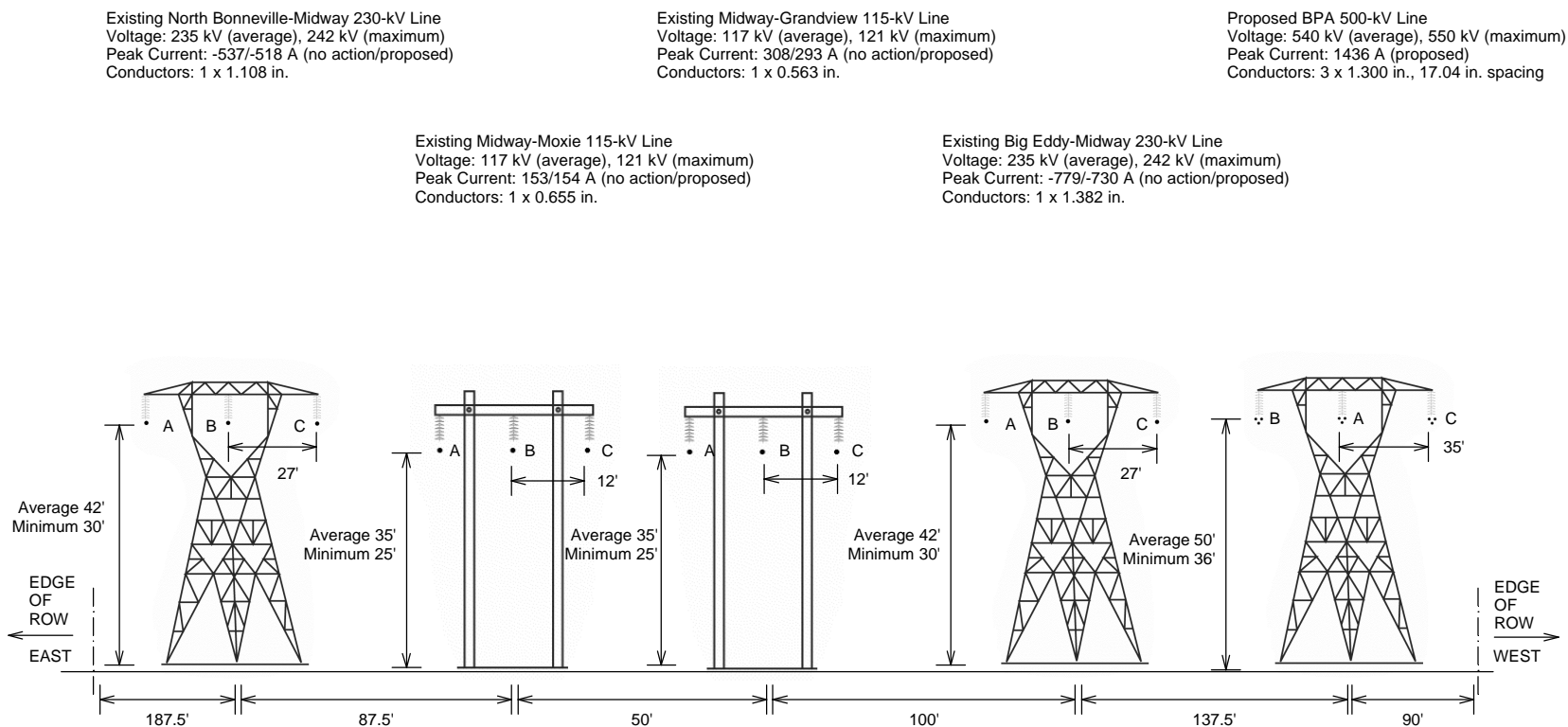
**Figure A2-1, continued**

d) Configuration D-1B - Proposed 500-kV line on flat structures parallel to Vantage – Midway 230-kV line (not to scale)



**Figure A2-1, continued**

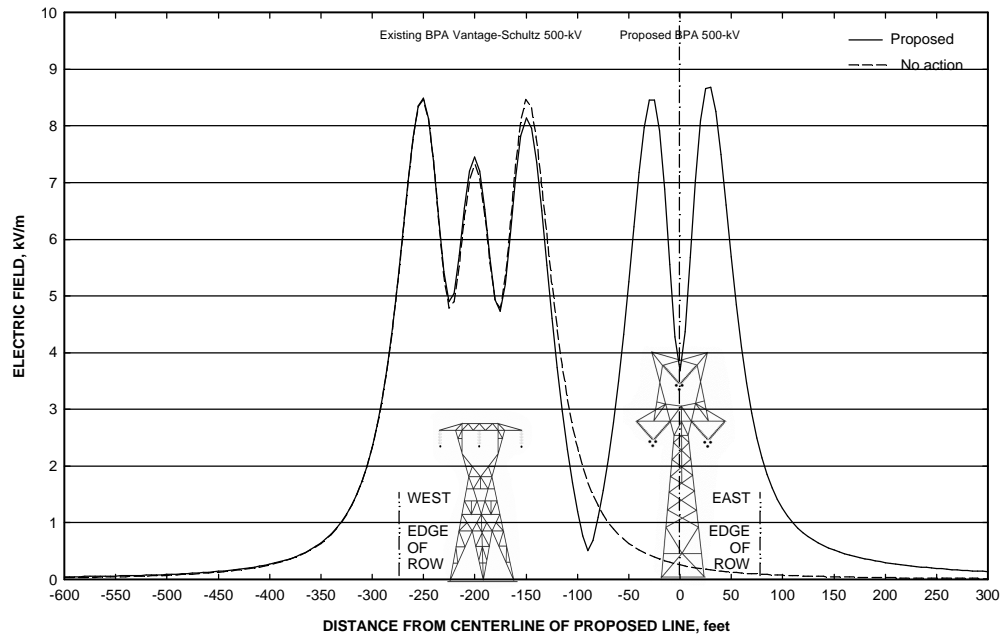
e) Configuration D-2A - Proposed 500-kV line on flat structures parallel to two 230-kV lines and two 115-kV lines (not to scale)



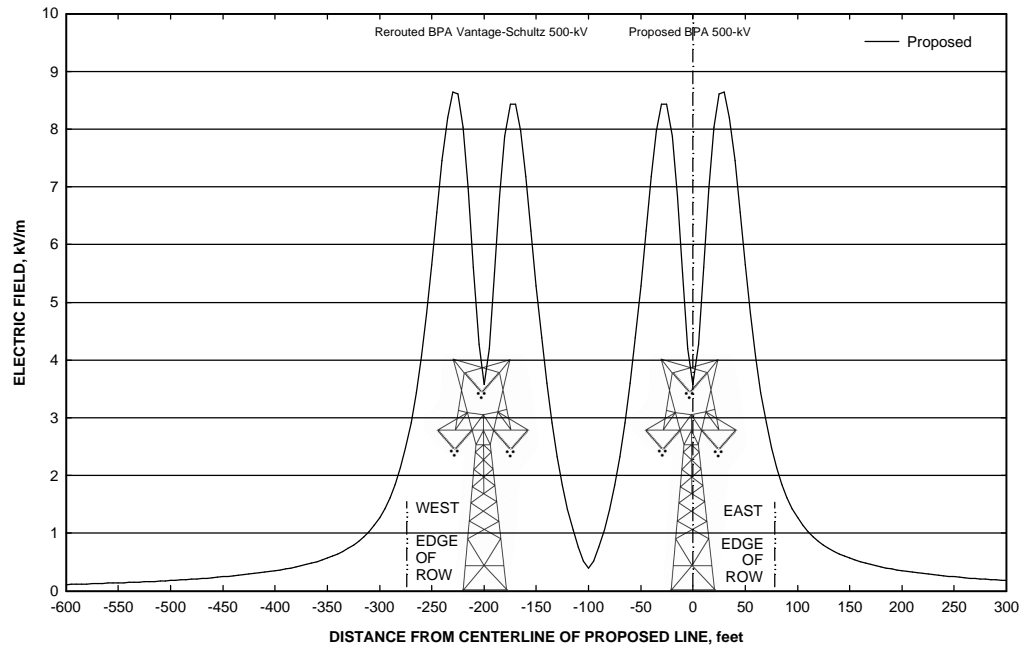
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**Figure A2-2: Electric-field profiles for new configurations of proposed Schultz – Hanford/ Wautoma 500-kV line for maximum voltage and minimum clearance:**  
**a) Configuration A-1A; b) Configuration A-1B; c) Configuration A-1C;**  
**d) Configuration D-1B; and e) Configuration D-2A. (3 pages)**

a) Configuration A-1A - Proposed 500-kV line parallel to existing Vantage – Schultz 500-kV line

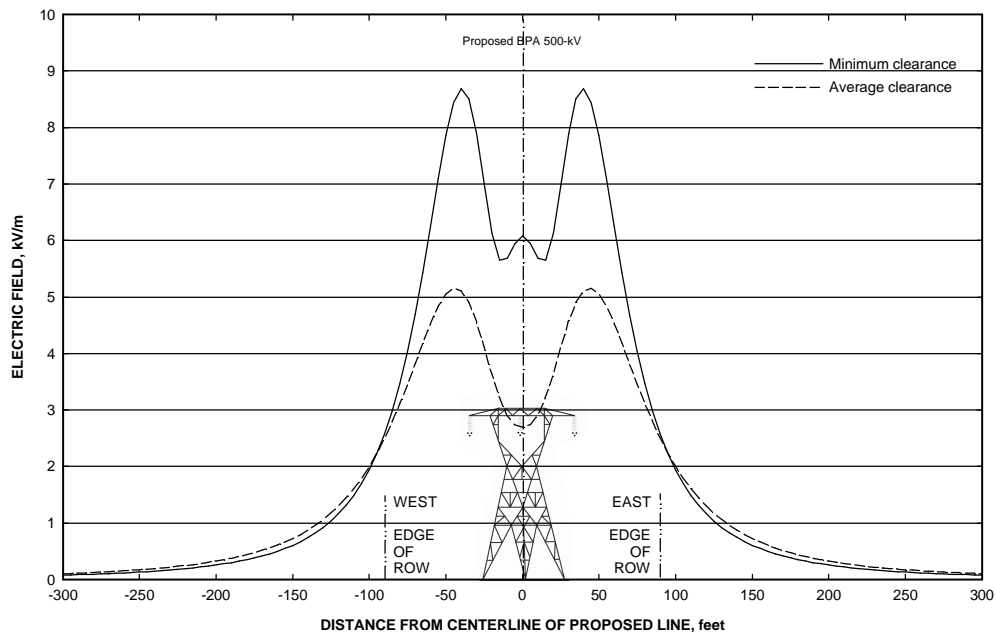


b) Configuration A-1B - Proposed 500-kV line parallel to rerouted Vantage – Schultz 500-kV line



**Figure A2-2, continued**

- c) Configuration A-1C - Proposed 500-kV line on flat configuration with no parallel lines



- d) Configuration D-1B - Proposed 500-kV line with flat configuration parallel to existing Vantage – Midway 230-kV line

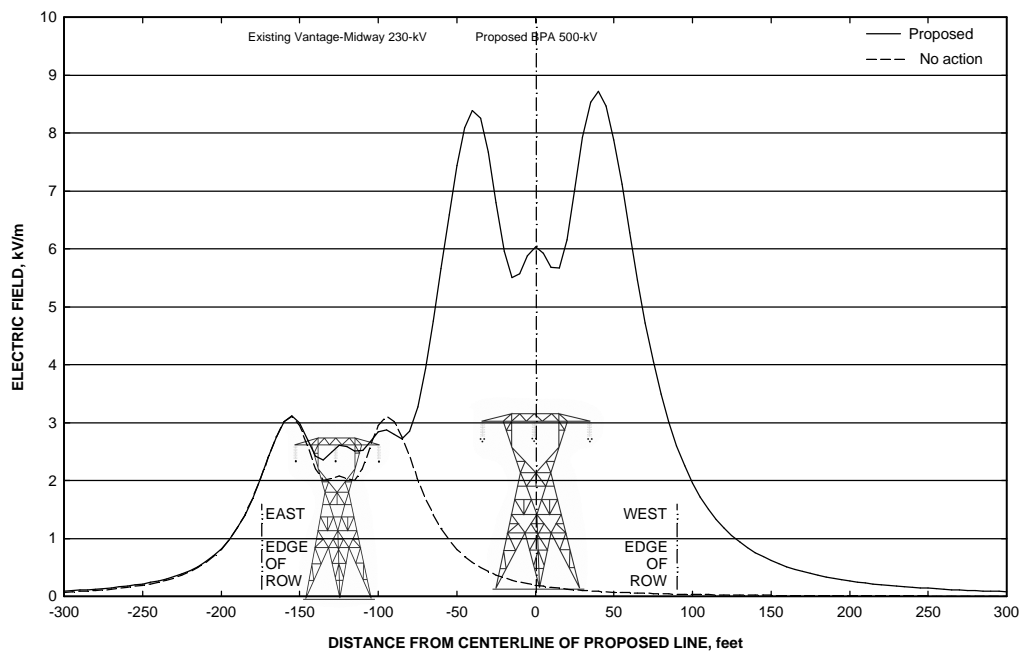
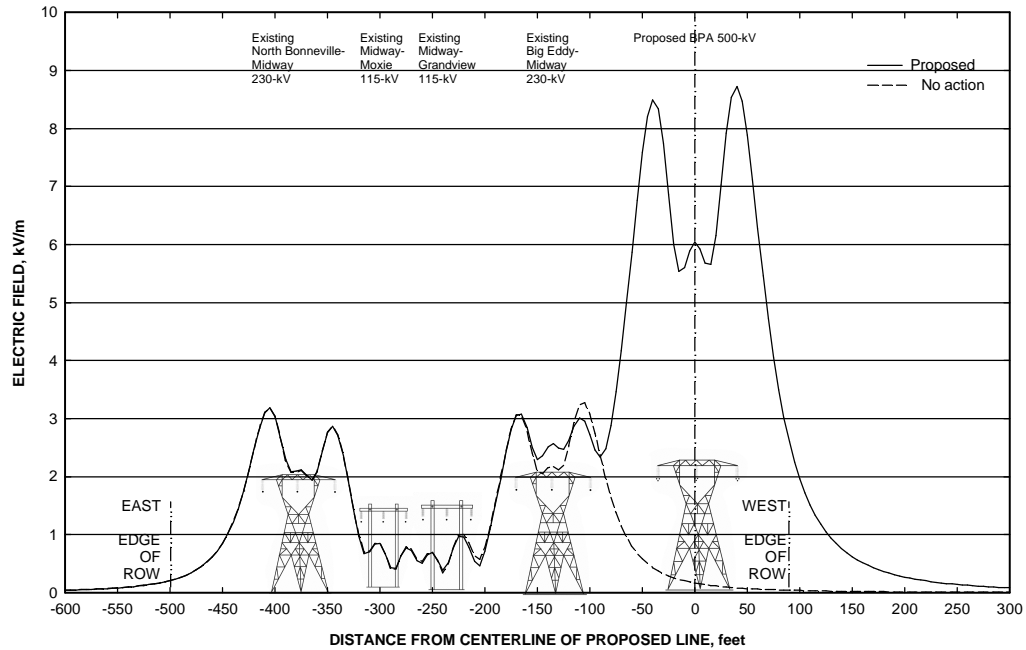


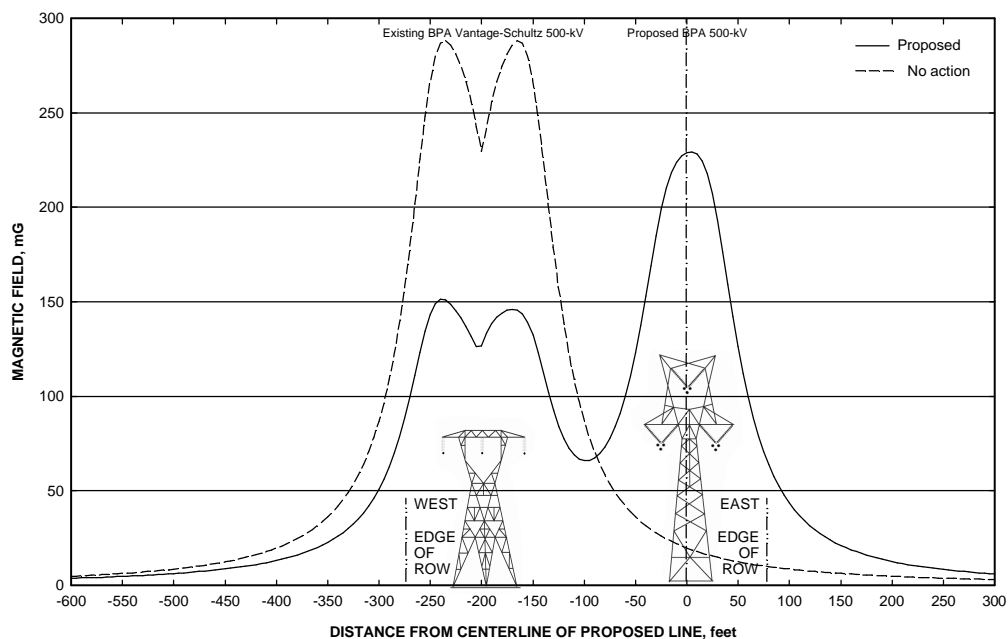
Figure A2-2, continued

- e) Configuration D-2A - Proposed 500-kV line with flat configuration parallel to two 230-kV lines and two 15-kV lines

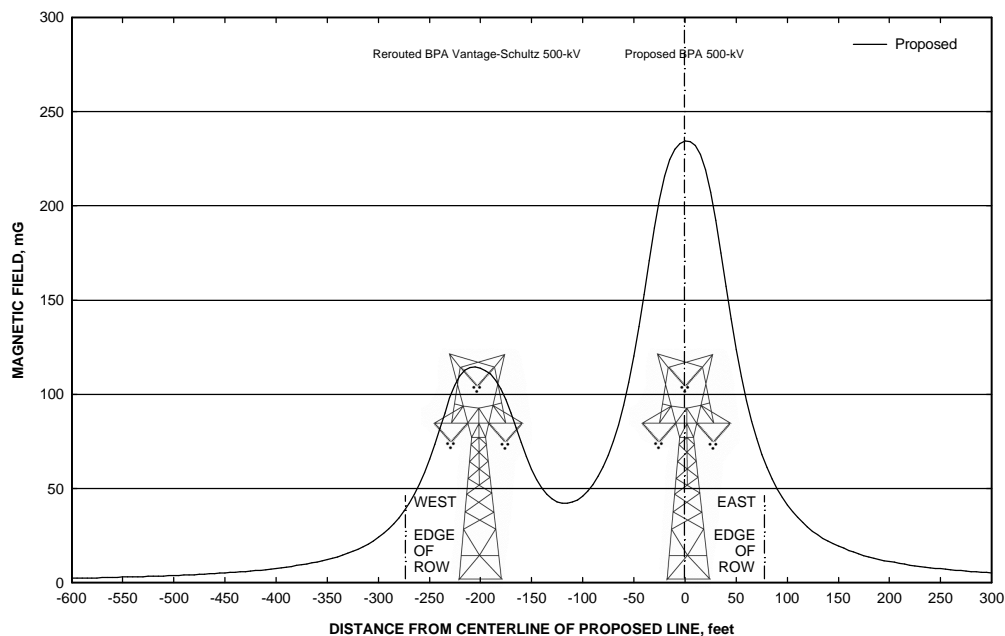


**Figure A2-3: Magnetic-field profiles for new configurations of the proposed Schultz – Hanford/Wautoma 500-kV line for maximum currents and minimum clearances: a) Configuration A-1A; b) Configuration A-1B; c) Configuration A-1C; d) Configuration D-1B; and e) Configuration D-2A. (3 pages)**

a) Configuration A-1A - Proposed 500-kV line parallel to existing Vantage – Schultz 500-kV line

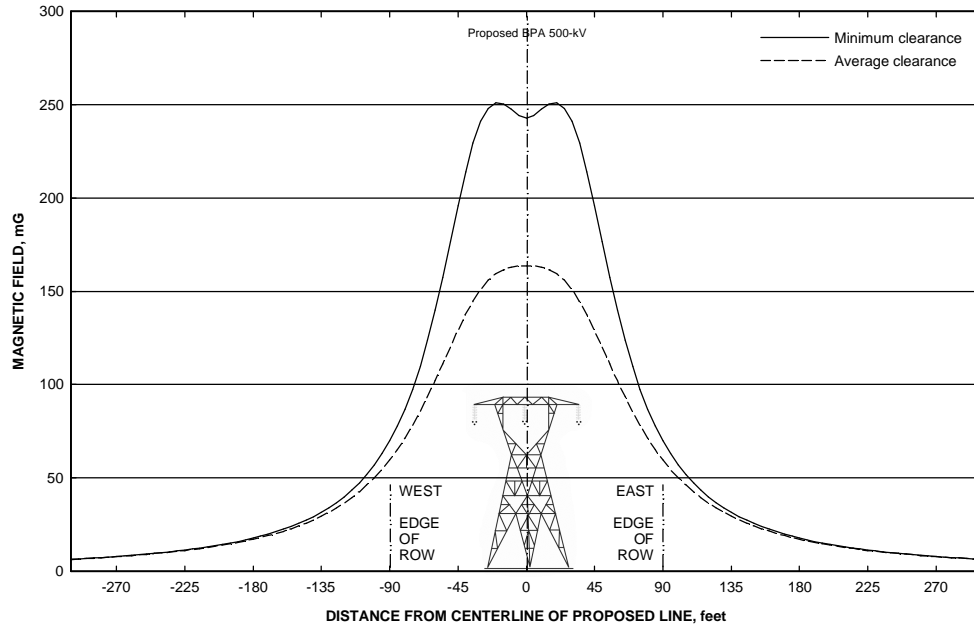


b) Configuration A-1B - Proposed 500-kV line parallel to rerouted Vantage – Schultz 500-kV line

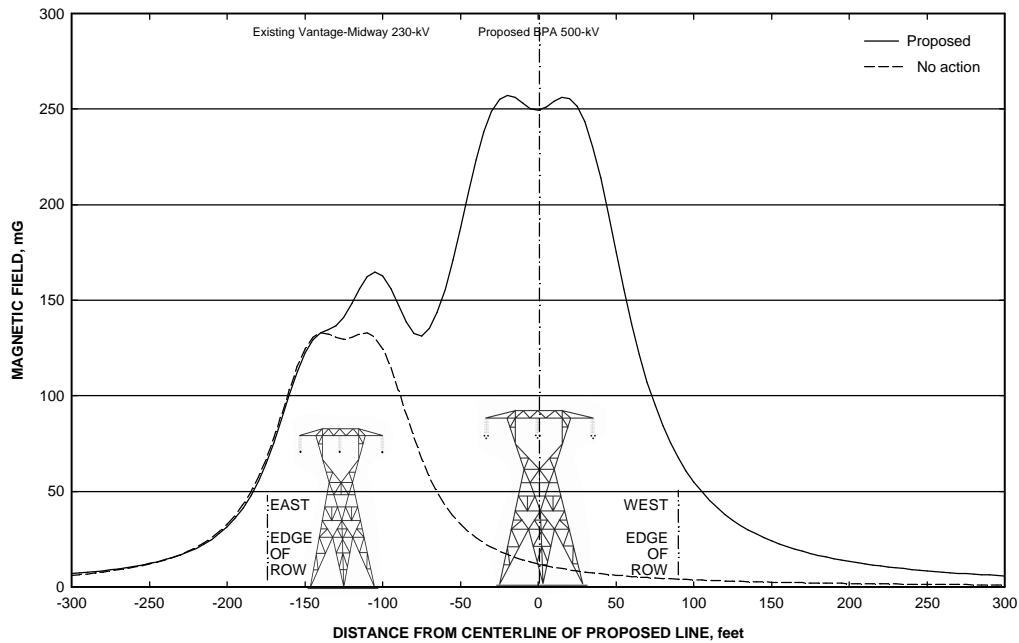


**Figure A2-3, continued**

- c) Configuration A-1C - Proposed 500-kV line on flat configuration with no parallel lines



- d) Configuration D-1B - Proposed 500-kV line with flat configuration parallel to existing Vantage – Midway 230-kV line



**Figure A2-3, continued**

- e) Configuration D-2A - Proposed 500-kV line with flat configuration parallel to two 230-kV lines and two 15-kV lines

